# United States Patent [19]

**Barger et al.**

[11] **4,381,591**

[45] **May 3, 1983**


[54] **METHOD OF ASSEMBLING MEDICAL FLUSHING VALVE**


[75] Inventors: **Larry N. Barger**, Glendale; **Kenneth R. McCord**, Lakewood, both of Calif.

[73] Assignee: **American Hospital Supply Corporation**, Evanston, Ill.



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**Related U.S. Application Data**

[62] Division of Ser. No. 32,832, Apr. 24, 1979, Pat. No. 4,267,835.

[51] **Int. Cl.**[3] ..... **B23P 15/00; A61M 5/00**

[52] **U.S. Cl.** ..... **29/157.1 R;** 29/450; 285/235; 251/342; 604/30; 604/153; 604/252

[58] **Field of Search** ..... 29/157.1 R, 157 R, 450, 29/451; 285/235, 236, 260; 251/342; 128/214 E, 247, 274, 276, 350



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*Primary Examiner*—Daniel C. Crane
*Attorney, Agent, or Firm*—Roger A. Williams



[57] **ABSTRACT**

A valve for an arterial monitoring set which continuously supplies a small flow of parenteral liquid, such as normal saline, into a patient's artery while arterial pressure is being continuously monitored. The valve has a flow restrictor providing a normally slow continuous flow rate and an elastically distortable tube which is manually squeezable to provide a fast flush rate. The valve is convenient for one hand operation. A method for assembling the valve by twisting the tube is also disclosed.


**3 Claims, 10 Drawing Figures**

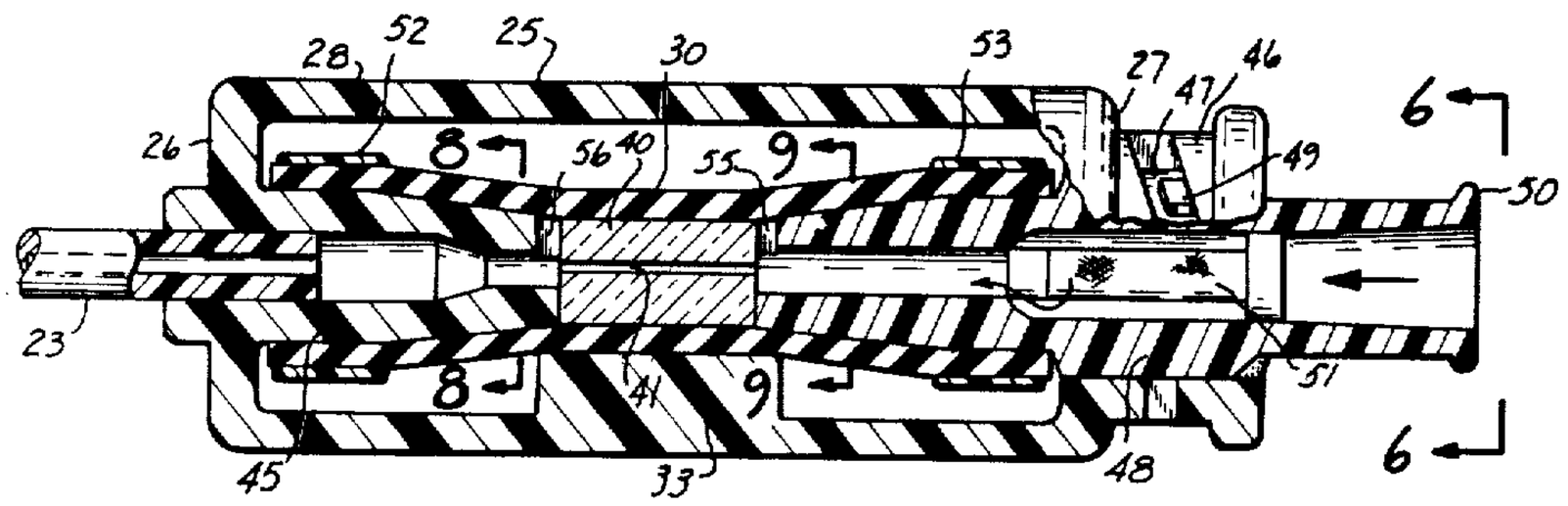


FIG. 1

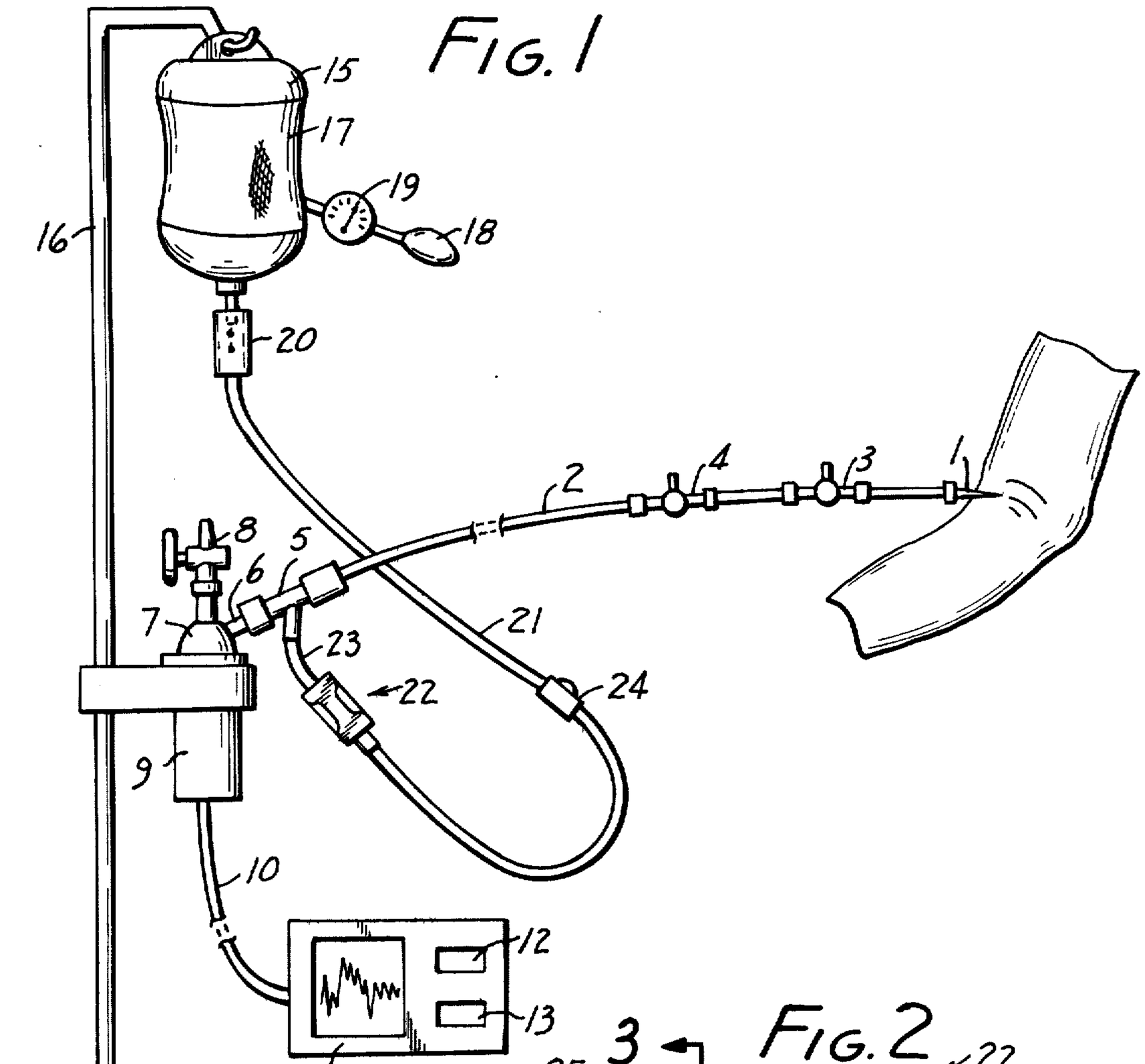



FIG. 2

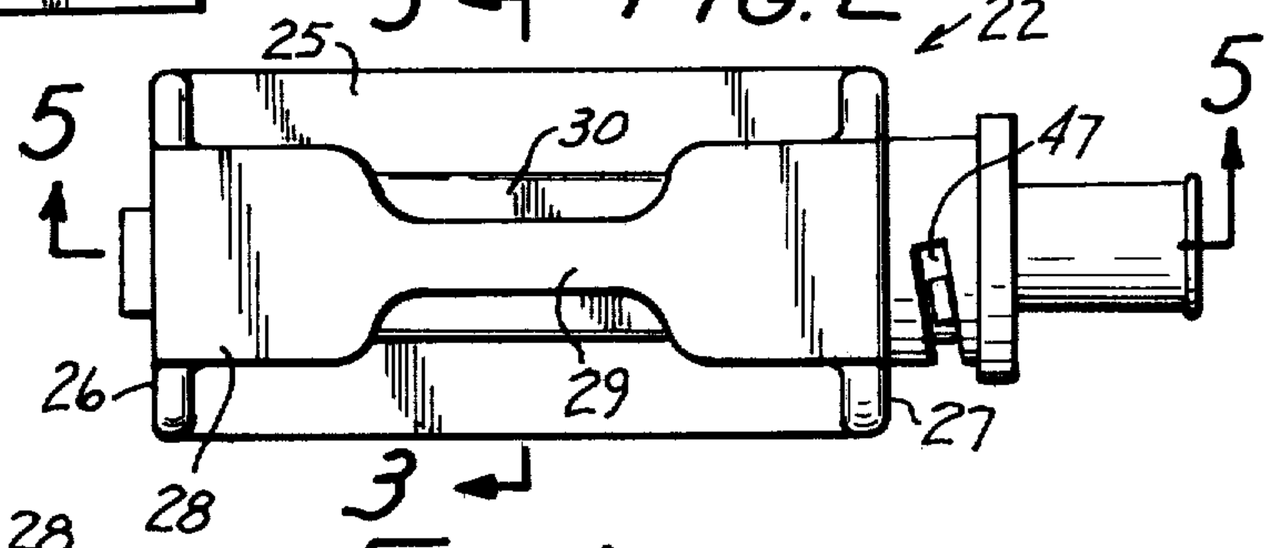



FIG. 3

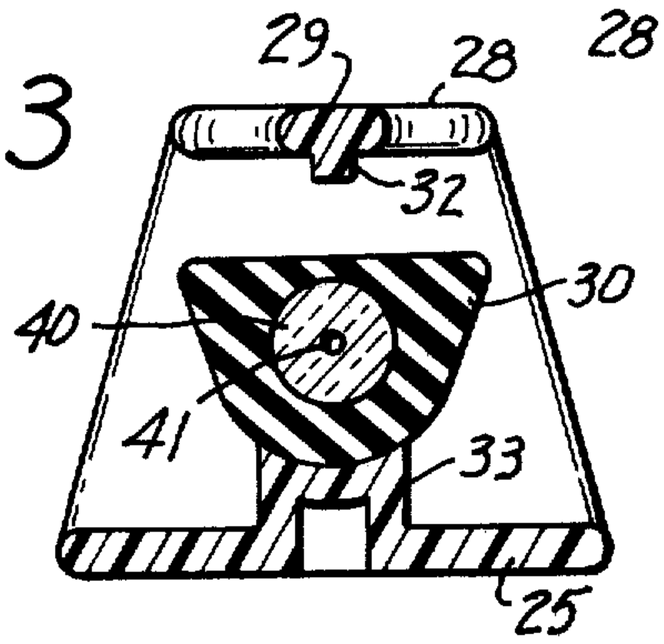
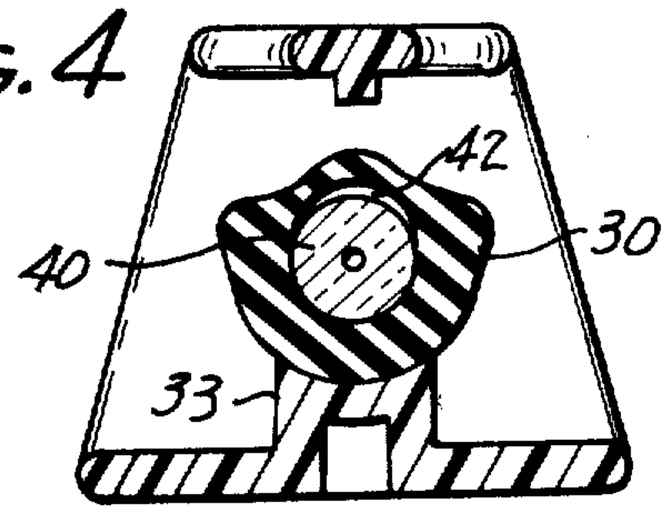



FIG. 4



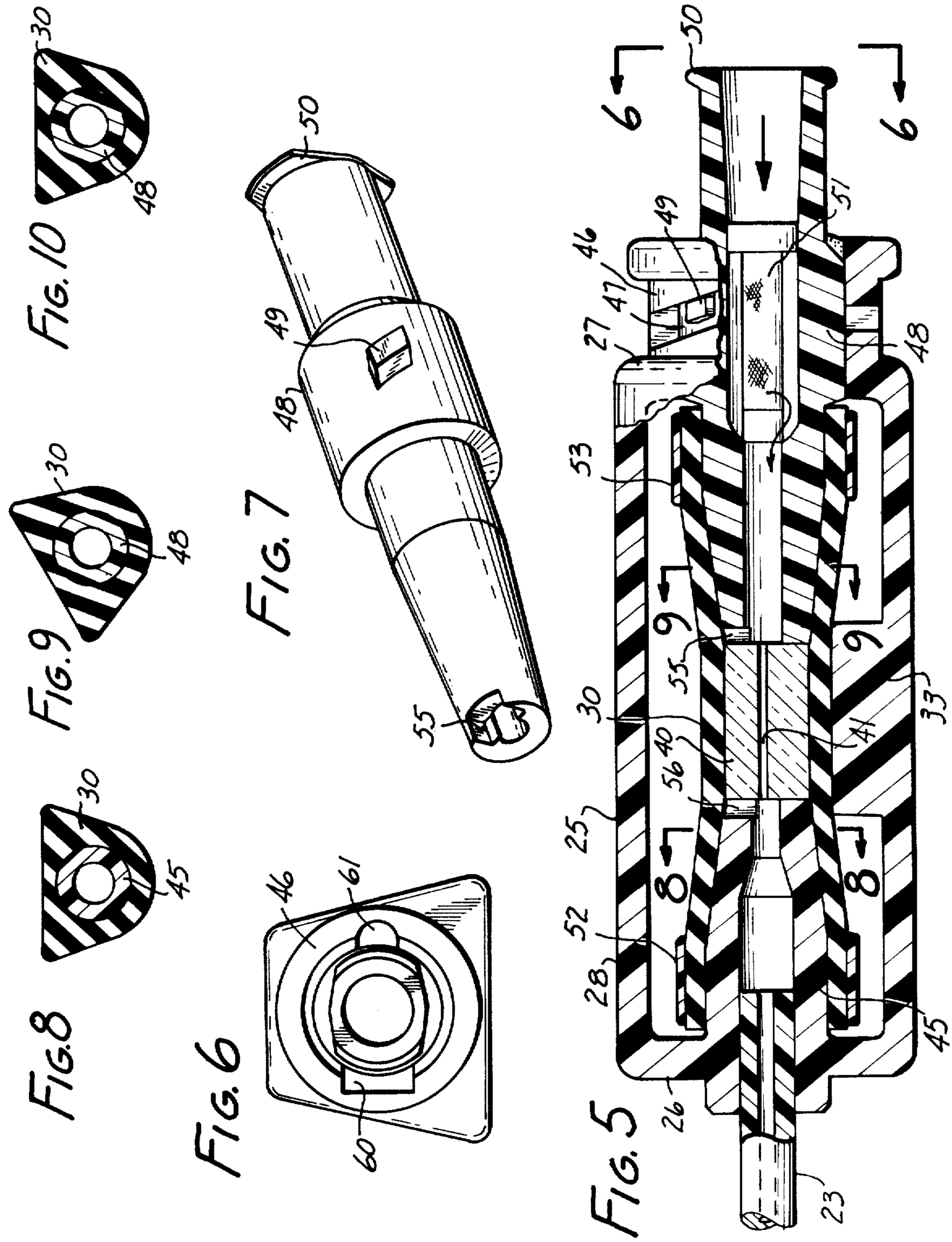


Fig. 10
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Fig. 9
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# METHOD OF ASSEMBLING MEDICAL FLUSHING VALVE

This application is a division, of application Ser. No. 32,832, filed 4/24/79, now U.S. Pat. No. 4,267,835, issued 5/19/81.

## BACKGROUND

U.S. Pat. No. 3,581,733 describes a system for continuously monitoring blood pressure within blood vessels and the heart. The system includes a catheter joined to a connecting tube leading to a pressure transducer that converts physical pressure signals into an electrical impulse which is then fed to a recording machine, such as an oscilloscope. As pressure readings can be seriously affected if blood should coagulate in any part of the pressure monitoring system, this patent describes continuously forcing a very slow flow of a physiological salt solution (normal saline would be an example) into the patient. This very slow flow rate is sufficient to prevent blood from backing up into the catheter and connecting tube, but is so slow that it does not cause any significant error in blood pressure reading.

Immediately after connecting the system to the patient and periodically through pressure monitoring, it becomes necessary to flush a larger amount of parenteral liquid into the patient, particularly to insure that the catheter or needle is completely free of blood. U.S. Pat. No. 3,581,733 does this flushing by a valve 18. Another type flushing valve is described in U.S. Pat. No. 3,675,891. The set up of the valve of this latter patent is described in the attached instructions for the valve made under Patent 3,675,891. This flushing valve has an elongated stem that must be pulled to actuate the valve. If the valve is not physically anchored to a rigid IV pole, transducer, etc., this operation requires two hands; i.e., one to hold the valve and one to pull the stem. Should the stem ever break off during the pulling action, the valve would be rendered useless. In addition, the valve of U.S. Pat. No. 3,675,891 includes a very large number of complicated parts including special sealing gaskets, etc.

## SUMMARY OF THE INVENTION

The present invention overcomes the problems described above and provides a flushing valve with a restrictor in an elastically distortable tube. The restrictor combines with the tube to form a slow flow rate passage and the tube is distortable, such as by squeezing, to temporarily form a flush passage with a much faster flow rate. An assembly method for the valve is described in which a pair of hollow connectors are joined to the elastically distortable tube and moved into abutting contact with the flow restrictor.

## THE DRAWINGS

FIG. **1** is an elevational view of a blood pressure monitoring system which includes the medical flushing valve;

FIG. **2** is an enlarged view of the flushing valve;

FIG. **3** is a sectional view taken along line **3—3** of FIG. **2** showing the valve in its unsqueezed condition or its normal slow flow rate;

FIG. **4** is a view similar to FIG. **3**, but showing the valve squeezed into its temporary fast flush condition;

FIG. **5** is an enlarged view, partially in section, taken along line **5—5** of FIG. **2**;



FIG. **6** is an end view taken along line **6—6** of FIG. **5**;

FIG. **7** is a perspective view of a hollow connector of the valve;

FIG. **8** is a sectional view taken along line **8—8** of FIG. **5**;

FIG. **9** is a sectional view taken along line **9—9** of FIG. **5** showing the position of the tube during assembly; and

FIG. **10** is a sectional view similar to FIG. **9**, but showing the position of the tube after assembly.

## DETAILED DESCRIPTION

In FIG. **1**, a system is shown for continuously monitoring blood pressure. This system has a hollow member **1**, such as a needle or catheter, inserted into a patient's vein or artery. Usually blood pressure is continuously monitored from an artery because this gives a more accurate and dynamic reading of the heart function. Hydraulic pressure from the patient's artery is transmitted through a connecting tube **2** which can have ports or stopcocks, such as **3** and **4**, for bleeding off blood samples or injecting medication into the patient. Tube **2** connects to a rigid T-connector **5** which is shown attached to a rigid arm **6** of a transducer pressure dome **7**. It is understood that the term T-connector is used in its broad sense to also include an angled Y-connector. The transducer dome **7** includes a bleed valve **8** for use in eliminating all air from the system prior to use. It is important that no air bubbles be in the system because this can affect the hydraulic liquid pressure wave generated by the patient's heartbeat.

The pressure dome **7** of the transducer can include a diaphragm (not shown) which can respond to liquid pressure vibrations and engage electrical strain means inside a transducer body **9** to convert hydraulic liquid pressure surges into electrical impulses. Such electrical impulses are fed through a line **10** to an instrument **11** for reading the pressure fluctuations in a patient's cardiovascular system. Instrument **11** can be an oscilloscope, an electronically activated stylus, etc. If desired, the instrument **11** can have other monitoring functions, such as at **12** and **13**, to monitor pulse rate, etc. in addition to blood pressure fluctuations at each heartbeat.

As explained above, the blood pressure monitoring for each heartbeat involves a liquid filled line between the patient and a diaphragm in the transducer dome. Since there is no liquid flow across the diaphragm of the transducer, there is no continuous blood flow out of the patient. This is why in U.S. Pat. No. 3,581, 733 it is necessary to very slowly force a small volume of parenteral liquid, such as normal saline, into the patient to prevent blood from backing up into the catheter and connecting tube **2** where it could coagulate over an extended period of time. Coagulated blood portions in the system can materially affect the accuracy of a pressure monitoring because such coagulated blood forms a restriction in the hydraulic pressure system. This very slow infusion of parenteral liquid (such as at 3 cc/hour) into the patient is from a container **15** supported on a pole structure **16**. Preferably, container **15** is of the collapsible bag type with a pressure cuff **17** that includes a squeeze bulb **18** and pressure gauge **19**. The parenteral liquid flows from container **15** through a drip chamber **20** and a connecting tube **21** to a valve shown generally at **22** which is joined by flexible tube segment **23** to the rigid T-connector **5**. Flow through connecting

tube **21** can be controlled by conventional roller clamp **23**.

The structure of the valve shown generally at **22** and the method of assembling this valve is the subject matter of the present invention. Related co-pending co-owned applications filed on the same day as the present application are "Method of Flushing A Medical Liquid," filed Apr. 24, 1979, Ser. No. 32,830 and issued as U.S. Pat. No. 4,267,833 on May 19, 1981; "System For Flushing A Medical Liquid," filed Apr. 24, 1979, Ser. No. 32,831, now U.S. Pat. No. 4,267,834, issued May 19, 1981; and "Protector Housing For Squeezable Valve" (Design), filed Apr. 24, 1979, Ser. No. 32,971, now U.S. Pat. No. Des. 266,790, issued Nov. 2, 1982.

In FIG. **2**, the enlarged view of the valve illustrates a protector housing that includes a base **25** connected to ends **26** and **27**, which in turn are connected to a top **28** that has a narrow central section **29**. Within the protector housing is an elastically distortable squeeze tube of rubber-like material, such as silicone. Preferably, this squeeze tube is generally transparent, or at least translucent to aid in detecting any air bubbles in the valve.

As shown in FIG. **3**, the top wall has a longitudinal bracing rib **32** which extends through its longitudinal length to strengthen narrow portion **29** of the top. Bottom wall **25** has a limit lug such as cradle **33**, with a concave surface, for preventing excess distortion of squeeze tube **30**. Preferably, squeeze tube **30** has a generally triangular cross-sectional shape.

In FIG. **3**, the valve is shown in its normal continuous slow flow rate position with the squeeze tube **30** sealingly engaging the periphery of a rigid glass flow restrictor **40** that has a bore **41** with a diameter of 0.001 to 0.004 inch. A diameter of 0.002 inch works very well and the restrictor can be made of glass tubing, such as is used for glass thermometers.

When it becomes necessary to fast flush the system of FIG. **1** with the parenteral liquid, the elastically distortable tube **30** is manually pinched through side openings of the protector housing. This causes the tube **30** to temporarily distort and create a flushing passage **42** around restrictor **40**. When this is done, cradle **33** prevents undue flexure in the valve which might dislocate the restrictor. Release of the squeeze tube **30** causes it to immediately resume the FIG. **3** configuration and the predetermined slow flow rate resumed.

Perhaps the valve structure can best be understood by referring to the enlarged sectional view in FIG. **5**. Here the housing's end wall **26** is integrally formed with a stationary hollow connector **45** which is joined to flexible tube segment **23**. End wall **27** of the protector housing is joined to a tubular retainer **46** that has a bayonet type locking channel **47**. This bayonet type lock can also be seen in FIG. **2**. Fitting within tubular retainer **46** is a longitudinally movable hollow connector **48** which has a bayonet type lug **49** which engages slot **47** of retainer **46**. Movable connector **49** has an internally tapered outer end and retaining ears **50** for connecting with connecting tube **21** leading from the parenteral liquid source.

As liquid is delivered from the pressurized parenteral liquid source in the system shown in FIG. **1**, it flows to the left as shown by the flow arrows in FIG. **5**. The liquid enters a hollow filter assembly **51** that is inside connector **48**. After the liquid exits through sides of the filter as shown by the arrow, it travels to the flow restrictor **40** and the pressure forces the liquid through the restricted passage **41**. The elastic tube **30** tightly seals against the external periphery of glass tube **40** and prevents any other passage of liquid other than through restricted passage **41**. To firmly hold ends of the tube **30** in place, compression shrink bands **52** and **53** can be used, if desired.

When it is desired to fast flush the system of FIG. **1**, the elastically distortable tube **30** is laterally squeezed between thumb and forefinger causing an upper portion of tube **30** to lift off of the periphery of glass tube **40** creating a flush passage. Thus, the liquid can flow through lateral passage **55** of connector **48**, and go around restrictor **40** and enter the passage of connector **45** through its lateral passage **56**.

It is important that air bubbles be eliminated from the system as they can interfere with the hydraulic pressure waves being transmitted from the patient to the transducer. For this reason, it is important that the hollow connectors **45** and **48** abuttingly engage ends of the restrictor **40** so no undue pockets are formed which could trap air bubbles. It has also been found that in cutting the glass flow restrictors **40**, their length sometimes varies. To accept variable lengths of the restrictor **40**, as well as eliminating any undue pockets to trap air bubbles, a special assembly method has been developed.

During assembly, the restrictor **40** is inserted into the squeeze tube and an end of tube **30** inserted on connector **45** which is fixedly joined to the protector housing. The squeeze tube has a configuration as shown in FIG. **8** at the area of assembly to connector **45**. Next the right end portion of squeeze tube **30** is angularly twisted as shown in FIG. **9** and a tapered end of movable connector **48** inserted into a right end of tube **30**. Lug **49** is then inserted into an entrance **60** of the bayonet type slot of the housing's retainer **46**. Preferably, retainer **46** has diametrically opposed entrances **60** and **61** that are of different sizes which match with different sized lugs on diametrically opposed sides of connector **48**. Thus, the connector **48** will always be oriented in the proper position so that its lateral port **55** is always at an upper part of the valve to correspond with the lateral port **56** of connector **45**.

Once the connector **48** and tube **30** that has been temporarily twisted at one end with a torquing force have been assembled, lug **49** is tightened in the bayonet slot **47**. The squeeze tube **30** also has a certain degree of elasticity that tends to untwist and tighten the connector **48**. Thus, the bayonet type lock compressively urges the connectors **45** and **48** into compressive engagement with ends of the glass restrictor **40**. If glass restrictor **40** varies slightly in length from one restrictor to the next, the bayonet structure can tolerate such variances. After the valve is assembled, the tube **30** resumes a shape generally shown at FIG. **10**.

It has been found that the flushing valve of the present invention works very well when the flow restrictor is of glass, the squeeze tube is of silicone rubber, and the protective housing and hollow adapters are made of a rigid thermoplastic material.

In the above description, a specific example has been used to illustrate the invention. However, it is understood by those skilled in the art that certain modifications can be made to this example without departing from the spirit and scope of the invention.

We claim:

1. A method of assembling a medical flushing valve comprising the steps of:

(a) sealing a restrictor inside an elastically distortable tube so the restrictor and tube combine to form a

flow passage with a predetermined flow rate leaving a portion of the distortable tube extending beyond the ends of the restrictor;

(b) securing one end of the distortable tube to a first hollow connector fixed within a housing, and securing the other end of the distortable tube to a second hollow connector which is movable with respect to the housing by twisting the elastically distortable tube with a torquing force and inserting the movable second hollow connector into the twisted end of the tube; and

(c) compressingly urging the first and second hollow connectors into sealing engagement with the restrictor.

2. A method as set forth in claim 1, wherein the method includes orienting the movable connector to a predetermined rotational position when attaching to the tube so that upon spiraling into sealing engagement with the restrictor a lateral port of the connector is at a particular rotational position.

3. A method as set forth in claim 2, wherein the movable connector is oriented to its particular position by orienting latch means on a bayonet type joint.

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